DOCUMENT RESUME

ED 221 551 TM 820 565

AUTHOR Davis, J. Kent; Cochran, Kathryn F.
TITLE Toward an Information Processing Analysis of Field-Independence.
PUB DATE Mar 82
NOTE 21p.; Paper presented at the Annual Meeting of the American Educational Research Association (66th, New York, NY, March 19-23, 1982).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Attention; *Cognitive Processes; *Cognitive Style; Individual Differences; Learning Motivation; Learning Processes; Literature Reviews; Long Term Memory
IDENTIFIERS Encoding Processes; *Field Dependence Independence

ABSTRACT

Goodenough's (1976) findings on field dependence/independence are extended here by focusing on the information processing stages of attention, encoding in short term and working memories, and storage and retrieval processes of long term memory. The reviewed research indicates that field independent and dependent individuals differ in the ability to restructure information in a perceptual and cognitive mode. This ability involves three components: (1) breaking down a complex stimulus into its component elements; (2) providing structure for an ambiguous stimulus complex; and (3) providing a different structure from that inherent in the stimulus complex. These studies indicate that field independent individuals are more adaptable in dealing with task ambiguity and the reorganization of information. Additional research is needed to more clearly identify the specific processes involved in these components. In addition, future research should explore reaction time tasks, cerebral hemisphere functions, taxonomy of mental operations, cognitive flexibility, and the performance of successful and unsuccessful learners within poles of the field dependence continuum. (PN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED221551

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

Toward an Information Processing Analysis of Field-independence

J. Kent Davis

Kathryn F. Cochran

Purdue University

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

J. K. Davis

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

TM 820 565

In R. E. Schutz (Chair), Trends in cognitive styles research: Directions and dilemmas. Symposium presented at the meeting of the American Educational Research Association, New York, 1982

Toward an Information Processing Analysis
of Field-independence

The dramatic developments in learning and memory research over the last decade or so have had at least two important implications for researchers concerned with the cognitive style dimension of field independence-dependence. First, the nearly total domination of the area by a cognitive view-point has provided a theoretical and methodological perspective for studying field dependence. This view point is most clearly reflected by a number of information processing models of cognition. Second, the area of individual differences has become a respected area of inquiry and is seen as offering a potential for furthering our understanding of the nature of cognition.

Our paper adopts a restricted approach to the diverse issues and objectives of this symposium. We limit ourselves to a consideration of only one cognitive style dimension. We further limit our discussion to recent research concerned with learning and memory and which can be viewed within a general information processing framework. The first section of our paper considers research conducted mainly since the publication of Goodenough's (1976) excellent review. Here we attempt to extend the findings of Goodenough by focusing on the information processing stages of attention, encoding in short term and working memories, and storage and retrieval processes of long term memory. The second section of our paper, adopts a critical view and argues that field independent-dependent researchers have not fully exploited the theoretical and methodological models afforded by the information processing perspective. Finally, we

suggest some future directions which this research might take to further our understanding of the information processing characteristics of field independent and field dependent learners.

Stages of Information Processing

Attention. Goodenough (1976) advanced a cue salience hypothesis as a means of accounting for the consistently poorer performance of field dependent learners on concept learning tasks. According to this hypothesis, field dependent learners are dominated by the most noticable or salient features of a stimulus, and thus they tend to ignore or overlook many features of the stimulus complex. The cue salience hypothesis suggests that field independent and field dependent individuals differ in terms of attentional processes.

Recently researchers interested in field dependence have begun to employ information processing paradigms as a means of examining attentional processes. The general research strategy employed has typically been to correlate measures of field independence (Rod and Frame Test and Group Embedded Figures Test) with various measures of attention including dichotic listening, signal detection, and visual search tasks.

This line of investigation has generally revealed that field dependent subjects are less effective in their performance on attention tasks. The following generalizations reflect the nature of this performance.

1. Field dependent subjects make greater errors than field independent subjects in both visual and auditory modes when they are asked to attend to a relevant stimulus in

the presence of a competing, irrelevant stimulus (Avolio, Alexander, Barrett & Sterns, 1981).

2. Field dependent subjects need a longer time to pick up information and are less flexible in eye movement patterns when the visual display is changing. That is, the field dependent individuals tend to confine their fixations to a smaller region within the total visual field (Shinar, McDowell, Rackoff, & Rockwell, 1978).
3. Field dependent subjects tend to be less effective in signal detection accuracy when the demands of the task are high (Forbes & Barrett, 1978).
4. Field dependent subjects have larger and greater numbers of eye movements during Rod and Frame Test performance. This finding suggests that part of the field dependent subjects deficit in performance on the rod and frame test is related to selective attention, and that field dependent subjects scan more of the visual field but are unable to selectively attend to the relevant part of the visual field (Blowers & O'Conner, 1978).
5. Field dependent subjects tend to prefer a slower pace of stimulus presentation in auditory and visual selective attention tasks. (Avolio, Alexander, Barrett & Sterns, 1979).

These recent studies demonstrate that field dependent subjects have a difficult time selectively attending to relevant cues particularly in the presence of distracting cues. While the results of these studies are quite consistent with Goodenough's hypothesis,

they also extend his cue salience hypothesis beyond concept learning to include a variety of selective attention tasks. Nevertheless, a number of issues remain to be clarified. Are the differences between field independent and field dependent learners due to different strategies, different processes, or differences in the capacity to attend to the demands of a particular task?

Encoding. If field dependence is related to attentional processes, then it would seem that field independent and field dependent learners would also differ in encoding processes. Some recent studies employing encoding specificity, digit span, and working memory tasks have supported this hypothesis.

For example, Frank (Note 1) employed an encoding-specificity paradigm and found that field independent and field dependent individuals did not differ when recall cues were the same as those presented during acquisition. When the recall cues were different, field independent individuals demonstrated better recall than field dependent subjects. Thus, it appears that field independent individuals encode information in a more versatile manner than do field dependent individuals.

Berger & Goldberger (1979) examined the relationship between field dependence and performance on a number of digit span tasks. Two general types of tasks were employed. One type of task was thought to tap the strength of registering a stimulus trace in short term memory, and the other type was thought to tap the ability to resist interference in consolidating a short term memory trace.

As predicted, there was no difference between field independent and field dependent individuals on the simpler, registration tasks, but field independent individuals did recall significantly more digits on the more difficult interference tasks. These results indicate that field independent and field dependent individuals differ in short term memory processes. Although the exact nature of these differences remain unclear, they may stem from attentional factors as suggested by Berger & Goldberger (1979), from differences in the capacity of short term memory, or from differences in the manner of encoding information.

Case and Pascual-Leone (Case, 1975; Case & Globerson, 1974; Pascual-leone, 1970) suggested that field independent and field dependent individuals differed in their effective use of working memory--a "central computing space" within which all current information processing occurs. Further support for the working memory hypothesis is provided by more recent research. Robinson & Bennink (1978) investigated recall errors and response time in a sentence transformation task. The extent to which working memory processes were tapped was manipulated through the use of high and low information load conditions. Under low information load, field independent and field dependent learners showed few differences, but field independent learners responded faster and with fewer errors in the high information load. These results were extended by Bennink & Spoelstra (1979) to inference and recognition processes. Again, recall and recognition performance of field independent individuals was significantly more accurate than that for field dependent individuals under conditions of high memory load.

These studies suggest that field dependence is related to differences in encoding processes. Moreover, they indicate that when a limited amount of information is processed there are little or no differences between field independent and field dependent learners. However, when larger amounts of information are processed, then field independent individuals are more efficient information processors than field dependent individuals.

Long Term Memory. Goodenough (1976) found little evidence to suggest that field dependence was related to performance on associative learning and memory tasks. However, some of the more recent research seems to imply that organizational processes do contribute to memory differences in field independent and field dependent learners.

Davis & Frank (1979) pointed out that results from free recall studies showed: a) that field independent learners tend to cluster more than field dependent learners, b) that word lists with more difficult patterns of organization are recalled better by field independent learners, and c) that field independent learners have better recall when given the opportunity to organize the material.

Research with more applied tasks confirms and extends these results. Stasz, Shavelson, Cox & Moore (1976) examined the organizational structure of concepts acquired in a social studies minicourse. They found that, after instruction, field independent subjects had greater differentiation among social studies concepts and a concept structure more closely related to the structure of the subject matter.

Research on the recall of information presented in prose passages has also implicated organizational processes. Spiro & Tirre (1980) reported that field independent students are more likely to utilize previous information as a means of facilitating recall than field dependent students. Annis (1979) reported that field independent students were better at learning and remembering textual information which was high in structural importance. Satterly & Telfer (1979) reported that field dependent students made the greatest gain when they were provided with an advance organizer that made explicit the organizing properties of the material to be learned.

While this line of research does not specify the precise processes involved, the findings are very consistent in suggesting that organizational processes do contribute to differences between field independent and field dependent learners. What remains to be determined is whether these differences are due to different processes for storing information, retrieving information, or to differences in both storage and retrieval processes.

In summary, the recent research which we have reviewed indicates that field independent individuals are better than field dependent individuals in selective attention, encoding, and long term memory processes. The conclusions drawn are also consistent with the cognitive restructuring hypothesis advanced by Witkin and Goodenough (1981). According to this hypothesis, field independent and dependent individuals differ in the ability to restructure information in a perceptual and cognitive mode. Furthermore, this ability is seen as involving three components: 1) breaking down

a stimulus complex into its component elements; 2) providing structure for an ambiguous stimulus complex; and, 3) providing a different structure to that inherent in the stimulus complex.

The first component, breaking down a stimulus complex, appears to be related to the process of attention. The current studies showed that field independent individuals attend to not only the salient elements but also to a broader range of elements of the stimulus complex. The second and third components of the restructuring hypothesis are also supported in a general sense by many of the encoding and long term memory studies that we have reviewed. These studies could be interpreted as showing that field independent individuals are more adaptable in dealing with task ambiguity and the reorganization of information. Additional research, however, is needed in order to more clearly identify the specific processes involved in these components.

Field Dependence and Information Processing

The research we have just summarized clearly points to information processing differences in field dependence. However, it is just a beginning. The vast majority of studies examining field dependence and learning have not fully capitilized on the theory and methodology afforded by information processing models. Two related problems with much of the previous research concern the type of research paradigm employed and the manner in which the results are interpreted. Much of this research has employed very global tasks which do not permit a clear identification of information processing components. This situation is further compounded by the tendency to then invoke information processing constructs as a means of explaining the differences between field

independent and field dependent learners. Thus, much of the research on field dependence has not utilized information processing tasks, but information processing constructs have been freely used to describe field dependence.

This state of affairs is surprising in that Messick (1970) characterized cognitive styles as "information processing habits" (p. 190). Such a characterization provided a definite direction for research and clearly implied that information processing paradigms held promise for furthering our understanding of field dependence. Only recently have a few investigators begun to follow Messick's suggestion by employing information processing paradigms.

Many researchers interested in other areas of individual differences have applied information processing paradigms in their research efforts. For example, Hunt, Frost & Lunneborg (1973) studied individual differences in verbal and quantitative abilities by employing a number of different information processing tasks. Similar research strategies have been followed in studying individual differences in anxiety (Muller, 1979), introversion-extroversion (Eysenck, 1977), and reading (Frederiksen, 1980). These approaches to individual differences provide a general research model which could be adapted by researchers concerned with learning and memory in field dependence.

Future Directions. While research on the information processing differences in field dependence has been slow to develop, we feel that many future directions hold promise.

One direction involves adopting research tasks designed to measure and isolate specific information processing components. The following tasks seem profitable because they have been employed frequently by researchers in the area of information processing and by researchers interested in individual differences:

1. The letter matching task developed by Posner and Mitchel (1967)
2. The memory scanning task developed by Sternberg (1969)
3. The working memory tasks developed by Baddeley and Hitch (1974)
4. The Brown-Peterson short term memory paradigm (Peterson & Peterson, 1959)

Another direction for future research concerns a more detailed analysis of simple and choice reaction times of field independent and field dependent individuals. Reaction time tasks have been employed in much of the information processing research, but little attention has been devoted to reaction time in field dependence research. Lunneborg (1977) reported significant, but moderately low, correlations between reaction time measures (motor reaction time and choice reaction time) and performance on the Hidden Figures Test. This relationship was obtained in one sample of high school students but was not replicated in another sample of high school students or in a sample of college students. These results imply that the relationship is complex and needs additional research. Also, Jensen (1980) has suggested that information processing speed as reflected by reaction time is an indicator of general intelligence. Thus, additional research on field dependence and

reaction time may help resolve the issue of whether or not field dependence is simply an expression of general intelligence.

Posner and McLeod (1982) have recently noted that important links between information processing and neuroscience have begun to develop. Such a link is also beginning to emerge in field dependence research in two separate directions. One direction involves a consideration of information processing differences between field independent and field dependent individuals in terms of cerebral hemispheric functioning (Bloom-Feshbach, 1980; O'Connor & Shaw, 1978; Oltman, Ehrlichman & Cox, 1977; Oltman, Semple & Goldstein, 1979; Zoccolotti & Oltman, 1978). Another direction concerns an examination of the physiological mechanisms which mediate performance on the Rod and Frame Test (Goodenough, 1981; Goodenough, Oltman, Sigman, Rosso & Mertz, 1979; Goodenough, Sigman, Oltman, Rosso & Mertz, 1979; Sigman, Goodenough & Flannagan, 1979). Continued research in these areas may provide an understanding of the neurophysiological basis for differences in learning and memory performance of field independent and field dependent learners.

Posner and McLeod (1982) have also proposed a taxonomy of mental operations within the domain of information processing. This model attempts to force finer distictions among such concepts as "processes", "strategies," "states," and "traits." Extentions of this taxonomy to the area of field dependence may hold promise both in terms of theoretical concerns and in terms of providing direction for additional learning and memory research.

Another direction for future field dependence research concerns exploration of the notion of cognitive flexibility which has been proposed by a number of researchers (Battig, 1979; Davis & Frank, 1979; MacLeod, 1979). According to the notion of cognitive flexibility, individuals differ in the range of available processes and or strategies they have available to perform on a given task. Much of the research we reviewed in this paper suggests that field independent individuals are more flexible in selecting efficient approaches to the tasks they are asked to perform. Therefore, the differences between field independent and field dependent learners may be due to having a greater repertoire of options available to them, to a greater willingness to try difference approaches, or to an ability to recognize that a particular approach is not the most efficient. Thus, differences in learning and memory may not be due to differences in the capacity of information processing systems, but rather to differences in the extent to which different information processing systems are available for the performance of a given task.

A final direction for future research which we believe holds promise is to compare the performance of successful and unsuccessful learners within poles of the field dependence continuum. Thus, the processes employed by successful field dependent learners would be compared with the processes employed by unsuccessful field dependent learners. Similar comparisons would be performed for field independent learners. This strategy for studying field dependence might be applied fruitfully to the area of reading.

As Davis, Kak and Frank (Note 2) pointed out, groups of problem readers contain both field independent and field dependent students. Therefore, it would be useful to know what approaches or processes the good field dependent readers employ that the poor field dependent readers do not employ. Likewise, it would be useful to know what approaches or processes the good field independent readers employ that the poor field independent readers do not employ. Obviously, information provided by adopting this research strategy would be helpful in adapting instructional approaches to the cognitive style of the students.

Summary. The recent research which we reviewed in this paper indicates that there are differences in the information processing characteristics of field independent and field dependent learners. Specifically, we found that field independent individuals are more efficient than field dependent individuals in selective attention, encoding, and long term memory processes. We also noted that, in general, the recent research was consistent with Witkin and Goodenough's (1981) cognitive restructuring hypothesis. While the recent research on field dependence and learning has begun to employ information processing paradigms, many future directions remain to be explored

Reference Notes

1. Frank, B. M. Memory and information processing of field-independent and field-dependent learners. Paper presented at the meeting of the American Educational Research Association, New York, March 1982.

2. Davis, J. K., Kak, A. V. & Frank, B. M. Implications of field-dependent/field-independent research reading. In Davey, B. (Chair), Implications of cognitive styles research for the study of reading. Symposium presented at the meeting of the American Educational Research Association, San Francisco, 1979.

References

Annis, L. F. Effect of cognitive style and learnings passage organization on study technique effectiveness. Journal of Educational Psychology, 1979, 71, 620-626.

Avolio, B. J., Alexander, R. A., Barrett, G. V., & Sterns, H. L. Analyzing preference for pace as a component of task performance. Perceptual & Motor Skills, 1979, 49, 667-674.

Avolio, B. J., Alexander, R. A., Barrett, G. V., & Sterns, H. L. Designing a measure of selective attention to assess individual differences in information processing. Applied Psychological Measurement, 1981, 5, 29-42.

Baddeley, A. D., & Hitch, G. Working memory. In G. H. Bower (Ed.), The psychology of learning and memory, Vol. 8, New York: Academic Press, 1974.

Battig, W. F. Are the important "individual differences" between or within individuals? Journal of Research in Personality, 1979 13, 546-558.

Bennink, C. D., & Spoelstra, T. Individual differences in field articulation as a factor in language comprehension. Journal of Research in Personality, 1979, 13, 480-489.

Berger, E., & Goldberger, L. Field dependence and short-term memory. Perceptual and Motor Skills, 1979, 49, 87-96.

Bloom-Feshback, J. Differentiation: Field dependence, spatial ability, and hemispheric specialization. Journal of Personality, 1980, 48, 135-148.

Blowers, G. H., & O'Connor, K. P. Relation of eye movements to errors on the rod-and-frame test. Perceptual and Motor Skills, 1978, 46, 719-725.

Case, R. Gearing the demands of instruction to the developmental capacities of the learner. Review of Educational Research, 1975, 45, 772-778.

Case, R., & Globerson, T. Field independence and central computing space. Child Development, 1974, 45, 772-778.

Davis, J. K., & Frank, B. M. Learning and memory of field independent-dependent individuals. Journal of Research in Personality, 1979, 13, 469-479.

Eysenk, M. W. Human memory: Theory, research and individual differences. New York: Pergamon Press, 1977.

Forbes, J. B., & Barrett, G. V. Individual abilities and task demands in relation to performance and satisfaction on two repetitive monitoring tasks. Journal of Applied Psychology, 1978, 63, 188-196.

Frederiksen, J. R. Component skills in reading: Measurement of individual differences through chronometric analysis. In R. E. Snow, P. Federico, & W. E. Montague (Eds.). Aptitudes, learning and instruction, Vol. 2, Hillsdale, New Jersey: Lawrence Erlbaum, 1980.

Goodenough, D. R. The role of individual differences in field dependence as a factor in learning and memory. Psychological Bulletin, 1976, 83, 675-694.

Goodenough, D. R. An entry in the great frame-tilt judging contest. Perceptual and Motor Skills, 1981, 52, 43-46.

Goodenough, D. R., Oltman, P. K., Sigman, E., Rosso, J., & Mertz, H. Orientation contrast effects in the rod-and-frame test. Perception and Psychophysics, 1979, 25, 419-424.

Goodenough, D. R., Sigman, E., Oltman, P. K., Rosso, J., & Mertz, H.

Eye torsion in response to a tilted visual stimulus. Vision Research, 1979, 19, 1177-1179.

Hunt, E., Frost, N., & Lunneborg, C. Individual differences in cognition: A new approach to intelligence. In G. H. Bower (Ed.), The psychology of learning and motivation, Vol. 7, New York: Academic Press, 1973.

Jensen, A. R. Chronometric analysis of intelligence. Journal of Social and Biological Structures, 1980, 3, 103-122.

Lunneborg, C. E. Choice reaction time: What role in ability measurement? Applied Psychological Measurement, 1977, 1, 309-330.

MacLeod, C. M. Individual differences in learning and memory: A unitary information processing approach. Journal of Research in Personality, 1979, 13, 530-545.

Messick, S. The criterion problem in the evaluation of instruction: Assessing possible, not just intended, outcomes. In Wittrock, M. C. & Wiley, D. (Eds.). The evaluation of instruction: Issues and problems. New York: Holt, Rinehart & Winston, 1970.

Muller, J. H. Anxiety and encoding processes in memory. Personality and Social Psychology Bulletin, 1979, 5, 288-294.

O'Connor, K. P., & Shaw, J. C. Field dependence, laterality and the EEG. Biological Psychology, 1978, 6, 93-109.

Oltman, P. K., Ehrlichman, H., & Cox, P. W. Field independence and laterality in the perception of faces. Perceptual and Motor Skills, 1977, 45, 255-260.

Oltman, P. K., Semple, C., & Goldsetin, L. Cognitive style and interhemispheric differentiation in the EEG. Neuropsychologia, 1979, 17, 699-702.

Pascual-Leone, J. A mathematical model for the transition rule in Piaget's developmental stages. Acta Psychologica, 1970, 32, 301-345.

Peterson, L. R., & Peterson, M. J. Short-term retention of individual verbal items. Journal of Experimental Psychology, 1959, 58, 193-198.

Posner, M. I., & McLeod, P. Information processing models- In search of elementary operations. Annual Review of Psychology, 1982, 33, 477-514.

Posner, M. I., & Mitchell, R. F. Chronometric analysis of classification. Psychological Review, 1967, 74, 392-409.

Robinson, J. A., & Bennink, C. D. Field articulation and working memory. Journal of Research in Personality, 1978, 12, 439-449.

Satterly, D. J., & Telfer, I. G. Cognitive style and advance organizers in learning and retention. British Journal of Educational Psychology, 1979, 49, 169-178.

Shinar, D., McDowell, E. D., Rackoff, N. J., & Rockwell, T. H. Field dependence and driver visual search behavior. Human Factors, 1978, 20, 553-559.

Sigman, E., Goodenough, D. R., & Flannagan, M. Instructions, instructions, illusory self-tilt and the rod-and-frame test. Quarterly Journal of Experimental Psychology, 1979, 31, 155-165.

Spiro, R. J., & Tirre, W. C. Individual differences in schema utilization during discourse processing. Journal of Educational Psychology, 1980, 72, 204-208.

Stasz, C., Shavelson, R. J., Cox, D. L., & Moore, C. A. Field independence and the structuring of knowledge in a social studies minicourse. Journal of Educational Psychology, 1976, 68, 550-558.

Sternberg, S. The discovery of processing stages: Extensions of Donder's method. Acta Psychologica, 1969, 30, 276-315.

Witkin, H. A. Cognitive styles: Essence and origins. New York: International Universities Press, 1981.

Zoccolotti, P., & Oltman, P. K. Field dependence and lateralization of verbal and configurational processing. Cortex, 1978, 14, 155-168.